THE COMBINED EFFECTS OF HEEL HEIGHT AND LOAD CARRIAGE ON POSTURE DURING GAIT: A PILOT STUDY

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INTRODUCTION: It is very common for women to walk in high-heeled shoes and carry a bag at the same time. These disturbances are combined and reduce stability during gait. Studies on gait pattern with high-heeled shoes report decrease in trunk flexion angle and increase in plantarflexion angle. High-heeled shoes shift the center of gravity of the subject anteriorly resulting in an unstable gait pattern (Gefen, 2002). Because feet provide a balance foundation for the body, unstable elevation of heel with high-heeled shoes will cause difficulty in balance. Previous studies with side load carriage done by Crosbie et al. (1994) also supported the unstable gait pattern and changes in posture due to the added load on one side. The effect of either heel height or load carriage would cause a compensatory postural adjustment differently, however, the combined effect on posture is unclear. The purpose of this study was to examine the combined effect of heel height and load carriage on posture during gait.

METHODS: A healthy female subject (mass = 48.3 kg; height = 164 cm; age 24 years) volunteered to participate for the study. The subject was free of musculoskeletal injury that may cause an abnormal gait during the test. A total of 41 reflective markers were attached on the subject from head to toe according to PlugIn Gait market set from VICON motion systems©. For each trial, the subject walked across the testing area of approximately 4 m. Five successive trials of each condition were recorded. Three load conditions equaled 0%, 10%, and 15% of the subject's body mass and three shoe height conditions equaled 0 cm, 4.5 cm, and 9 cm were combined and tested. The load was carried on one strap purse on right shoulder to mimic the general female population wearing high-heeled shoes. VICON motion system© (Vicon Motion System Limited, England) was used to capture 3-dimensional motion with six infrared cameras. From the collected kinematic data, knee and ankle angles in sagittal plane, trunk angles in sagittal and frontal planes, head acceleration pattern and temporal gait parameters were determined and further analyzed. Two-way multivariate analysis of variance (MANOVA) was conducted to determine the significant main effect by load carriage and shoe height. ($p < 0.05$).

RESULTS AND DISCUSSION: The results of this study indicate that the heel heights did not have significant effect on knee joint in flexion-extension movements regardless of the added mass during swing and stance phase. But the high-heeled shoes alone significantly alter the ankle joint with greater plantarflexion. To keep the centre of mass over the base of support, compensational trunk movement in frontal plane was evident in all load carriage conditions. When both load and height were added during the gait, there was a concomitant decrease in stride time and length and walking velocity. Head acceleration demonstrated less rhythmic and more irregular pattern when the body was under adjustment for balance due to combined effect of high-heeled shoes and load. The results suggest that increased heel height and load combined change posture significantly which in turn reduces stability and increases the risk of injury.

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